OBSERVATIONS ON BILHARZIOSIS IN IRAQ.

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The invasion of the human body by worms of the genus Schistosomidae is no new thing. By the researches of the late Sir: A. Ruffer the prevalence of Schistosomiasis in Egypt as far back as the twentieth dynasty (1250 - 1200 B.C.) has been established.[i] To clinical observers, haematuria and dysentery, the most outstanding manifestations of a Schistosome infection, have been known to prevail in Egypt for centuries but it was not until 1851 that Bilharzia by finding in the human portal venous system adult digenetic trematode worms proved the association between these worms and the symptoms they produce. Siebold published the results of Bilharz's Work and gave the disease the name of Bilharzia (vel Bilharziasis vel Bilharziosis)[ii] As the causal worms belong to the genus Schistosomidae the disease is also known as Schistosomiasis.

The life cycle of Schistosomidae in general was known to consist of a sexual phase spent in a vertebrate - the definitive host - and of an asexual phase spent in a mollusc - the intermediate host. The life cycle of those Schistosomes which invade man, however, had puzzled investigators for many years but the work of the Bilharzia Mission under Leiper elucidated the problem and on that work depends most of our present day knowledge of Bilharzia. Leiper's complete results have been published in a masterly treatise and will be frequently referred to.[iii] He showed that in Egypt:-

A. There are two distinct Schistosomes which pass through their sexual phase in human beings
   (a) Schistosoma Haematobium which deposits numerous terminal spined ova mainly in the bladder wall.
   (b) Schistosoma Mansoni which deposits a much smaller number of ova with lateral spines mainly in the wall of the rectum.

B. That the asexual phase of Schistosoma Haematobium takes place only in the molluscs Bullinus Dybowski and Bullinus Contortus while the asexual phase of Schistosoma Mansoni takes place only in the mollusc Planorbis Boissyi.

Another species of Schistosome has been shown to invade man but as it occurs only in the Far East it will not be considered here. Other workers maintain that there are additional species of molluscs capable of acting as intermediate hosts for Schistosoma Haematobium and Schistosoma Mansoni and this assertion seems to have been proved within the last few months by the investigations of Dye in South Africa.

The ova of these Schistosomes are, as noted above deposited in the wall of the bladder or rectum of infected human beings, from there they are discharged with the urine or faeces and if they reach water they hatch out almost immediately into active ciliated miricidia which seek about for a mollusc to invade. In the liver of the mollusc they produce Sporocysts from which there develope cercariae with very definite charactistics. These cercariae are in turn set free in the water and invade man to begin the sexual phase over again. Unless the miracidia reach a molluscan host within a maximum period of forty eight hours they die and a similar fate overtakes the cercariae unless they reach their human host within a like period. These points are of importance to remember in considering methods of prophylaxis and eradication. The route which cercariae gain entrance to their human host wasfor long the subject of controversy but Leiper by making paraffin sections of a newly-born mouse which had been immersed for half an hour in cercariae-infected water was able to demonstrate cercariae in various stages of actually penetrating the whole skin. He also showed that monkeys, protected from skin infection, developed Bilharzia after drinking cercariae-containing water and that, as cercariae are rapidly killed by the gastric juices, such infection must have taken place through the mucosa of the alimentary tract between the lips and the stomach. Having penetrated the skin or mucosa the cercariae gain access to the

general circulation and we next find them in the venules of the portal circulation where they develop into adult male and female worms. The mature worms then pair, the male folding itself around the female and in this position they migrate against the blood stream towards the radicles of the portal vein progressing by means of a ventral sucker which they possess. The great majority choose to enter the inferior mesenteric vein through which they gain access to the small veins surrounding the rectum and the base of the bladder. The female worm then leaves the male and being of smaller calibre continues its course and deposits its ova in the venules of the submucous coat of the bladder and rectum. It then withdraws to rejoin the male worm and leaves its ova so placed that the force of the blood stream drives their spine through the vessel wall. When a number of ova are thus deposited close together the overlying mucosa sloughs and the ova enter the cavity of the viscus to be voided with the urine or faeces as the case may be. The time which elapses between exposure to cercariae - containing water and the appearance of symptoms is usually about six weeks. Clinically the diagnosis of infection in man is made by the discovery by microscopical examination of typical ova in the urine or faeces.

In surveying our present knowledge of the life cycle of Schistosome worms it would appear that there are two points which are not yet fully explained.

1. The course taken by the cercariae between their penetration of the skin or mucosa of their human host and their arrival in the venules of the liver. Leiper considers this point requires further investigation but Fairley and Bahr say "After penetrating the skin or mucosa the cercariae are conveyed by the venous system to the right heart and so to the lungs.

Here they may conceivably be temporarily held up by the pulmonary capillaries but eventually reach the portal vein and liver. The lung of a monkey exposed to heavy infection three days previously showed no cercariae on section". An analogy between the behaviour of these cercariae and those of the larvae of ankylostoma duodenale at once suggests itself. These latter have the same mode of entry into the human body, are carried by the circulation to the lung capillaries where they leave the blood vessels and become free in the alveoli. They pass up the trachea with the secretion from the alveoli to reach their maturing ground, the alimentary tract, via the oesophagus. So far experiments have failed to establish that schistosome cercariae adopt a similar route and we must admit that the point requires further elucidation.

2. The adult worms when they migrate from the liver - a nd the actual migration has been observed in an exposed mesentery - have the choice of entry into any of the radicles of the portal vein but almost invariably they enter the inferior mesenteric vein. Down this vessel they proceed to the superior haemorroidal vein which drains the series of dilated sinuses which constitute the haemorroidal plexus. That plexus communicates freely in front with the vesical plexus and through it with the pudendal plexus; it is also drained by the middle haemorroidal vein, a tributary of the internal iliac vein. The worms have thus access to all the great venous plexuses surrounding the rectum, bladder and prostate and from those have access to the systemic venous circulation via the middle haemorrhoidal vein. In thousands of cases I have seen where the presence of ova in the urine has proved the presence of worms in the vesical plexus it has struck me as strange that none presented symptoms suggesting that the adult worms had passed further into the systemic circulation and held up by the lung capillaries. Even cases due to the passage of ova into the general circulation are rare. What influence, then, guides the worms from the liver into the inferior mesenteric vein, the only tributary of the portal vein which will give them access to the vesical plexus and what influence discourages them from

passing on further into the systemic venous circulation. Considering the absence of valves in the portal venous system and the arrangement of the valves which exist in the systemic veins I am inclined to think the influence is not a mechanical one. Can it be of the nature of a chemiotaxis exerted by some substance absorbed from the lower end of the bowel or must we be satisfied to regard the migration in the same light as that of the guinea worm which "conformably to her instinct" (as Manson Bahr says) when mature bores through the tissues to that part of the body surface most liable to come in contact with water. This "instinct" in ordinary cases leads the worm to the legs and feet but in the case of water carriers whose occupation means that their back is constantly wet the same "instinct" directs the guinea worm to the skin at the back.

In its vertebrate host the Schistosome may produce an infection of a latent type, its symptoms may apparently be of a local character or more rarely it may produce death rapidly by blocking the portal circulation. Milton, speaking from an extensive experience of the disease in Egypt, says "Bilharzia itself is quite equal to the task of destroying its victim which it does in a large number of cases and with unspeakable torture",[VII] A disease against which such an indictment can be pronounced surely demands the efforts of all to alleviate the suffering it produces and to eradicate it from those countries where it prevails.

A detailed account of the geographical distribution of Human Schistosomiasis has been given by Milton.[VIII] The disease, as noted above is very widespread in Egypt. In South Africa it is also very common and of 625 our soldiers who became infected during the South African War 359 were still drawing pensions in 1911.[IX] Harley has published the results of much work he has done on the subject there.[X] Its presence as an endemic disease in Western Australia has been established while most of the cases reported from India appear to have been imported from other countries.[XII, XIII] The

disease has also been reported from other parts of North Africa from East and West Africa, from the West Indies, Central America, Palestine, Arabia and Persia. In 1921 an account of cases occurring in Portugal was published. It was first reported from the country now known as Iraq by Sturrock in 1899. I quote in full Dr. Sturrock's letter from page 1543 of the British Medical Journal of 2nd December, 1899.

"In Tropical Diseases by Patrick Manson M.D.F.R.C.S., published by Cassell & Co. in 1898 the geographical distribution of Bilharzia Haematobia is stated to be limited to Africa and its island dependencies. I regret to say that the disease is widespread throughout Mesopotamia occurring in those living in towns and villages situated on the banks of the river Tigris and Euphrates I have been able to trace it up to about 900 miles from the mouth of the united rivers but so far no patients have applied for treatment who dwell upon the rivers where the Influence of the Persian Gulf is felt. Vesical Calculus is more common above Baghdad where apparently there are more cases of Bilharzia Haematobia".

P.S. Sturrock, M.B.B.C. Church Missionary Society, Baghdad.

Attention was next drawn to the existence of the disease in Iraq by an outbreak which occurred in 1917, among the Indian personnel of one of the military hospitals in Basrah. It was at first thought that the disease had been imported and the infection spread by an Egyptian labour Corps which was encamped near the hospital, but investigations proved that Bilharzia was endemic in the neighbourhood and also in many of the surrounding districts. An interesting account of this epidemic was published by Boulenger.

The writer of the present article served with the army in Iraq for two years and subsequently in the Iraq Health Service from 1919 to 1922; he had, therefore, ample opportunity for observing the disease as it effects many parts of Iraq. The extent to which the disease is endemic throughout the country is not fully brought out by either of the reports mentioned above. My experience would lead me to say that Bilharzia is most prevalent

on the Euphrates Valley from the Hindiyah Barrage to the sea. That it does exist in areas affected by the tide of the Persian Gulf will be shown later.

The problem of the disease in Iraq differs according to the locality in which it is met and I shall therefore discuss it as it occurs first in a typical rural area and secondly as it occurs in an urban district.

Bilharzia in a rural area of Iraq namely the division or Liwa of Diwaniyeh.

The Liwa of Diwaniyeh takes its name from the town so called, situate just over a hundred miles from Baghdad on what used to be the main Euphrates channel. The channel of the rivers in Iraq is subject to frequent alteration occurring as the result of silting. About fifty years ago the Euphrates forsook the channel on which Diwaniyeh stands and it was only in 1913, after the erection of the Hindiyeh Barrage eighty miles up stream of that town, that an adequate amount of water was redirected down to old channel now known as Hillah channel.
The water so redirected is almost all used up for irrigation purposes and only a small quantity finds its way back to the main channel a few miles above Samawah town. The amount of water entering the Hillah channel can be regulated by the adjustment of the barrage gates. Eleven miles upstream of Diwaniyeh the Hillah channel divides into two - the Dagharah channel which spends itself in the desert and the Rumaitha channel which flows past Diwaniyeh on through the district of Rumaitha to rejoin the main channel. The Liwa, therefore, depends upon the activities of the irrigation department at the Hindiyah barrage for the supply of water which makes it capable of supporting its large population of 200000 souls. We shall see later that on the further activities of that department will depend the improvement of the health of the district so far as Bilharzia

is concerned. Almost the entire population is engaged in agricultural pursuits and their work in the fields, barefooted, means constant exposure to infection from Bilharzia.

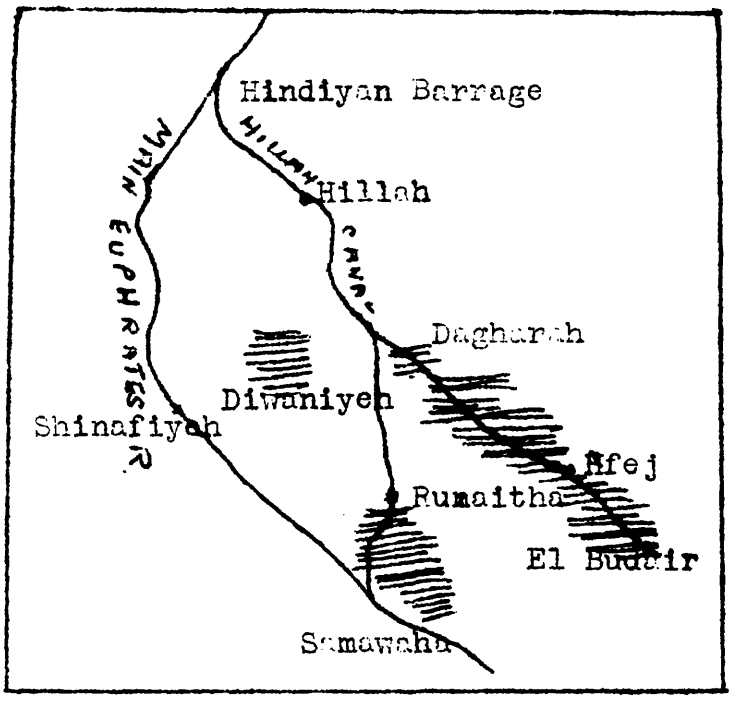
The land may be divided into two types

(a) Flow land which is on such a level relative to the adjacent river that it can be watered by the natural flow of water led in channels radiating from a breach in the river bank. Such land unless the breach in the river bank be closed receives a constant supply of water and is therefore a suitable breeding place for molluscs all the year round. It is cheap to farm and is consequently thickly populated.

(b) Lift-land which is on such a level relative to the adjacent river that the water does not flow on to it but must be raised by means of water wheels or pumps before it can be distributed over the surface. Such mechanical devices are expensive to work and are only put into operation when the crops require water consequently there are long periods between crops when the land is dry and therefore unsuitable as a breeding place for molluscs.

The towns of the Liwa whose population exceeds 5000 number eight and of these three are built on land not liable to flooding either by overflow or seepage while within the bounds of the other five water is liable to collect and form suitable breeding places for molluscs.

To this Liwa of Diwaniyeh I was posted as Civil Surgeon in March 1919, having previously spent a year in the area as medical officer of an Indian Regiment. After a few weeks work in the out-patient department I became convinced that the district was heavily infected with Bilharzia. Intelligent local inhabitants consider that at least eighty per cent of the population is infected and my experience, gathered in routine hospital work and at cliniques held during frequent tours of the division suggests that such an assessment is no exaggeration. Further experience showed that practically all the cases came from the "flow" land and from the low lying towns in the small irrigation channels and stagnant pools of which innumerable snails could be found. Infected snails are readily recognised even by the naked eye as their shells are friable and the swollen liver of the mollusc shining through gives the shells



Sketch map showing the bifurcation of the Hillah Canal and the most heavily infected areas in the Diwaniyeh Liwa.

a yellow appearance. The Higher towns and the lift land produced very few cases and it was very rarely that any snails could be found in their waters. While a regimental medical officer I encouraged bathing parades in these waters and not a single case of infection took place. Conditions in the district were unsettled, laboratory equipment was meagre and pressure of other work was great but many hundreds of microscopical examinations were made and in all cases the infection was found to be due to Schistosoma Haematobium. My personal records of these cases were unfortunately not recovered after the rebellion of 1920. Cases occurred at all ages from two years upwards and even in patients who had more than reached the allotted span. Rectal symptoms were exceptional nor did uncomplicated cases of Bilharzia frequently apply for treatment. Haematuria is so common that it has come to be regarded as a normal rather than an abnormal condition. The majority of the patients came seeking relif for conditions which, although they did not realize the fact were sequelae of a Bilharzia infection. Anaemia with its consequent debility, pyogenic infections of the bladder, hydronephrosis, pyonephrosis, periurethral abscess, stricture, urinary fistulae both of the roof and floor variety, vesical, urethral and renal calculus, these were among the conditions we were most frequently called upon to treat. Carcinoma, among natives is a rare condition but I have twice seen carcinoma of the bladder associated with a Bilharzial infection. Lithotrity and lithotomy were the operations which headed our operation list. In such a district symptomatic treatment was the only one which could be adopted. It might be argued that if the uncomplicated disease does not drive the ordinary citizen to seek treatment it cannot therefore interfere much with the life of the community. I am convinced, however, that it does to a serious extent affect the stamina and labour producing power of the population and think the point is well illustrated by our experience in the case of the local levies or gendarmerie. In the early days men were

enlisted into those services without medical examination but it was soon found that a large number of these men were unable to stand the strain of sustained military training. They were then sent to me for examination and almost without exception their incapacity was found to be due solely to debility resulting from constant haematuria. Action, then is called for to raise the population from its C III standard but curative methods will be of no avail if they are not accompanied by preventative methods. Curative methods on a scale which would make any impression on the prevalence of the disease would involve a huge staff and great expenditure. Just as what we call curative methods would break the life cycle of the schistosome within its human host so preventative measures must aim at breaking the life cycle of the worm outside that host. The conceptions of sanitation which the ordinary rural Arab has, if indeed he has any, are such as to render impracticable any scheme to deal with the ova in the infective discharges of the human host. Destruction of the cercariae would be futile unless we at the same time destroyed the molluscs which continually produce them. Our only hope then is to destroy the intermediate host which keeps up the supply of cercariae and any plan we adopt to do this must be practicable and economical and at the same time there must be reasonable prospect of its being followed by such a measure of success as to make it worth while.

The possibility of materially reducing the molluscan fauna by means of ducks and wild fowl has been considered in Egypt.[XXII] [XXIII] As huge flocks of ducks, the numbers and varieties of which must be seen to be believed - inhabit the low lying areas of Iraq for five months each winter I am convinced that such a proposal must occupy a very subsidiary part in any serious scheme for dealing with the country at large. It might, however, be useful in dealing with small localised areas where infection exists.

Leiper has shown that after being subjected to drying for a period of fifteen days very few snails recover.[XXIV] Can we

devise any scheme applicable to a district such as Diwaniyeh by which this method of destroying the intermediate host by drying can be put into operation? The crops at present consist of winter crops of wheat and barley grown on lift land and on the higher levels of flow land and summer crops, chiefly rice, grown on the lower flow land especially near the termination of the Dagharah and Rumaitha branches. The winter crops require water up to the end of March while the summer crops are watered up till the end of August. To ensure thorough drying of the Molluscs for fifteen days would involve closing the canals for at least two summer months because of the time required for the water to drain off and evaporate from the canal beds. The drying process already takes place in all lift areas and in the high level towns; it can be accomplished by building regulators at the head of canals irrigating the higher flow lands; while in low lying rice growing districts and towns it can be only accomplished by completely stopping the flow of water in the Dagharah and Rumaitha channels. Nothing therefore short of complete closure of the Dagharah and Rumaitha channels will effect drying in all the areas concerned. One objection which might be raised is that there would remain during the drying period no water for the drinking and house-hold supply of the population but from experience of previous dry periods of a somewhat shorter duration I am of the opinion that deep wells in the channel beds would afford an ample water supply for two months. The drying process is therefore practicable in all the districts under consideration.

What expenditure would be involved in carrying out the process In lift areas none. In high level flow areas the construction of regulators is also desirable for irrigation purposes and is indeed already a part of the programme of the Irrigation department and would therefore involve no expenditure which has not already been foreshadowed. The complete closure by means of a temporary Arab brushwood and earth dam of either the Dagharah or the Rumaitha canal where they are formed by the bifurcation of the Hillah channel would cost only a few thousand rupees and considering

the large amount of revenue which the Diwaniyeh pays the central funds this small expenditure cannot be grudged. In addition to the actual outlay, however, the closure of either the Dagharah or the Rumaitha canal would involve the sacrifice of the Summer crops grown on the area irrigated from that particular canal and consequently would involve loss of revenue from the area. If the Dagharah canal were dealt with one year and the Rumaitha canal during a subsequent year the effect on the total revenue would not be severe. Unfortunately the nature of the soil in those low lying areas is such that, while they will bear a summer crop they are not suitable for growing winter crops, therefore substitution is not feasible. The prohibition of summer crop raising for one year on the Dagharah canal and for a subsequent year on the Rumaitha canal would not, if due warning were given, be responsible for any undue disturbance in these areas. The low lying Towns would of course benefit from these measures but one other factor is worthy of mention in their case. The houses in these towns are built almost entirely of soil mixed with water and chopped straw to a consistency suitable for moulding into bricks. The Arab to avoid ~~the~~ trouble and expense takes the soil from the nearest available source and consequently the zealous builder leaves in his trail a series of excavations in the ground. These soon fill with seepage water and form ideal breeding places for snails. The water in them is stagnant and soon comes to contain cercariae in much greater concentration than the slow flowing water of the irrigation channels. The filling in of such excavations will mean the removal of a frequent source of infection.

Could it be reasonably expected that such a scheme to carry out the drying process would be followed by success in such measure as to justify its adoption. In my mind the existing state of affairs in the lift land furnishes the answer to this question and the answer is an emphatic "Yes". The Hinaidi experiments quoted later in this paper also support the view that this scheme would achieve success. The destruction of the vast majority of

the molluscs would inevitably follow the drying process and, although an infected population would still remain, the miracidia hatching from the ova in their infective discharge would have little or no chance of finding an intermediate host and the life cycle would be terminated. Consequently re-infection of man would not occur, those already infected would have a chance to recover from this often fatal and always exhausting disease and those not already infected, including the rising generation would not have to pay the heavy toll in life and suffering which has been exacted from previous generations.

A scheme along the following lines would, I suggest, be practicable, successful and not beyond the financial capabilities of the country.

A. The early construction of head regulators on all channels which tap the Dagharah and Rumaitha canals. Complete closure of these regulators after the requirements of the Winter crops have been satisfied. Being permanent structures these regulators remain available for future use should molluscs reappear.

B. Complete closure of the Dagharah canal for two months after next Winter crop is mature followed in a subsequent year by similar complete closure of the Rumaitha canal.

C. The supply of facilities for curative treatment in the heavily infected areas on the Dagharah and Rumaitha canals. Being a strong believer in the power of the human body to rid itself of Bilharzia infection provided re-infection is not constantly occurring I lay comparatively little importance on this part of the scheme and it has the additional disadvantage that to be carried out on a large scale it would involve considerable expenditure.

D. The filling in of all pits lodging stagnant water within the low lying towns and the prohibition of further excavations within their limits.

The first effect of these measures may be an apparent increase in the incidence of Bilharzia because when the water is first cut

off from the canals the concentration of cercariae in them is increased on account of the diminished volume of water. I have noticed this increased incidence following the period when the whole canal has been closed for the annual repairs at the Barrage. The eventual result of the scheme would, I am convinced, prove that any money expended had been soundly invested and would pay a handsome dividend in the shape of a reduced mortality and in a dimunition of the number of C.III members of the community. The problem of Bilharzia, therefore in a rural area of Iraq, such as we have been considering, although it presents many difficulties, presents none which are insuperable.

Bilharzia is an Urban District of Iraq - namely the town of Basrah.

Basrah stands on the right bank of the Shatt-el-Arab, the river which is formed by the confluence of the Euphrates and Tigris. The effect of the tide of the Persian Gulf can be felt for a hundred miles above the mouth of this river so that Basrah standing only sixty miles from the Gulf is well within the range of the tide. Basrah is the port of Iraq and most of the inhabitants depend on their existence on various commercial activities. There is considerable pilgrim traffic through it from Persia, India and other Mohammedan countries and there is much coming and going of merchandise between it and Persia and Arabia both by land and by way of the ports on the Persial Gulf. It is thus easily understood that people becoming infected with Bilharzia in Basrah are liable to spread the infection over a wide area. The town of Basrah has a population of 50,000 distributed mainly at Ashar on the bank of the river (20,000) and at Basrah City one and a half miles south of the river bank (30,000). Between, and surrounding these densely populated areas are many gardens containing date palms, other varieties of fruit trees and numerous vegetable plots. These gardens are watered by innumerable small water channels taking off from three main canals each of which, separated from its neighbour by

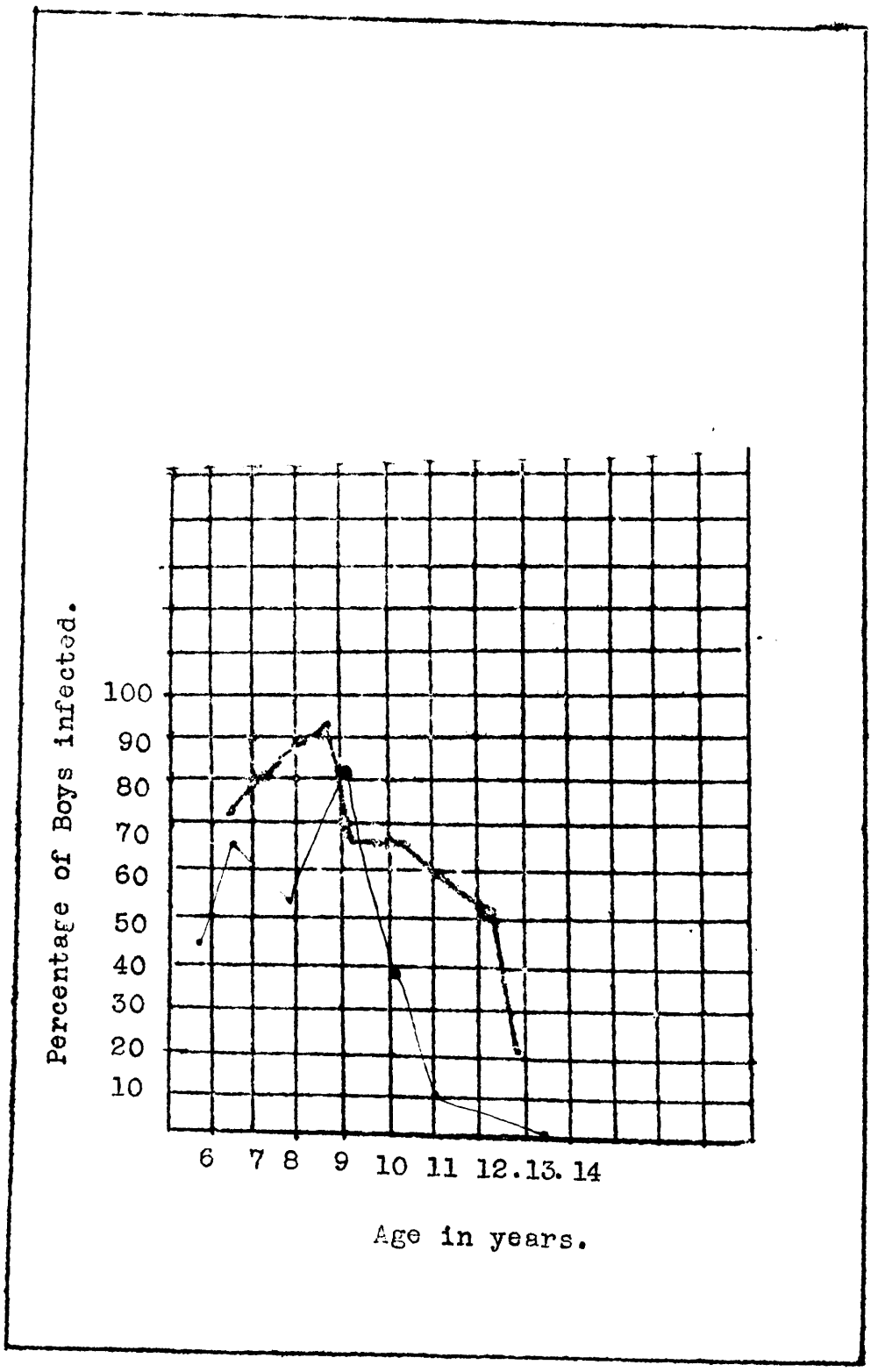
a distance of half a mile, pursues a course out towards the desert in a direction at right angles to the river. Besides carrying water for irrigation purposes these three main creeks are the source of water supply of the bulk of the population, are the constant scene of the washing of their household utensils and clothes while in the hot weather they present the most attractive bathing place available for a throng of children. I was posted to the Civil Hospital Basrah in 1920 and took up the investigation into the incidence of Bilharzia among the schoolboys there. The diagnosis in all cases was based on microscopical examination of a freshly passed specimen of urine and a negative diagnosis was never made unless a centrifuged specimen showed no ova. It is useless to accept the statement of the boys as may be realised by the fact that amongst the boys of a class of twenty-two, sixteen of whom were infected, six of those were unaware of their infection although their urine contained ova and blood cells. The results of the investigation showed:-

Session 1920-21.

Class	Total No. of children examined.	No. of children found to be infected.	Percentage infected.
Infants	34	21	62
1st. Elementary A.	31	20	65
" " B.	43	33	77
2nd Elementary	40	31	78
1st. Primary	31	18	58
2nd "	14	8	57
3rd "	6	3	50
4th "	7	3	43
1st Secondary	16	3	19
Total	222	140	63%
American School.	65	31	48%
Jewish School	50	8	16%

Graph showing age incidence amongst boys of Government School.

Black 1920 - 21
Red 1921 - 22



Session 1921 - 22.

Government School. Class.	Total No. of children examined.	No. of children found to be infected	Percentage infected.
Infants	23	9	39
1st. Primary	28	22	58
2nd Elementary	27	13	38
1st. Primary	22	16	73
2nd. Primary	27	10	37
3rd "	14	2	14
4th "	7	0	0
Total	158	72	47%
American School.			
Primary	68	30	44
Middle School	43	19	44
High School	11	4	36
Total	122	53	43%
Jewish School.			
Elementary	6	1	17
Primary	88	26	30
Total	94	27	29%

Thus out of a total of 711 children examined 331 or 47% were infected with Schistosoma Haematobium. The statistics in the government school show an improvement in the second year owing to the fact that some of the children, although not included in the first year's statistics received treatment during that year. It was thought that Christian and Jewish children showed a greater resistance to the disease than Mohammedan children and this conception seemed to be borne out by an analysis of the examinations of the pupils of the American School which is a mixed one. The analysis of the results in that school for 1922 showed that :-

Of Mohammedan Children 57% were infected
" Christian " 30% " "
" Jewish " 27% " "

This difference in incidence among the children of different religious persuasions can be explained, I think, not by any difference in resistance but by a difference in habits, for the Christian and Jewish Children bathe in the creeks much less frequently than the others and consequently are less exposed to infection. Many Mohammedan families too still hold to the belief that water stored or treated in any way loses its "virtue" and therefore although a

wholesome supply for household purposes may be available they persist in using what they describe as "living" water direct from the creek. The protection afforded by foot gear which is nearly always worn by Jews also help to reduce their incidence.

The incidonce of the disease amongst boys seems to increase till about the age of nine and then it decreases. The infection in Basrah although wide spread is not nearly so severe as in Diwaniyeh and the course of the incidence curve is explained by a tendency towards spontaneous cure rather than by the disease killing off the weaker of its victims. This contention is further substantiated by the fact that the urine of many boys who gave a definite history of haematuria failed to show ova after careful and repeated examination.

The effect of the disease on the physical development of the children is obvious and one has little difficulty in picking out from a class those infected. The face is pale, thin and pinched and they wear a tired expression. They exhibit a nervous restlessness. To determine the effect on the mental development of the children I asked the principal of the American School to classify the boys of his school as regards their intelligence and progress and applied his classification to the boys I found to be infected. The result was:-

Class	Intelligence of Boys Infected.		
	Below Average	Average	Above average.
Primary	9 (30%)	11 (37%)	10 (33%)
Middle School	4 (21%)	11 (58%)	4 (21%)
High School	0 (0%)	3 (75%)	1 (25%)
Total	13	25	15
Percentage.	24. 5%	47. 2%	28. 3%

Class	Intelligence of Boys not infected.		
	Below Average	Average	Above average
Primary	5 (13%)	16 (41%)	18 (46%)
Middle	3 (12%)	16 (67%)	5 (21%)
High	3 (33%)	1 (11%)	5 (56%)
	11	33	28
Percentage.	15.3%	45.7%	39%

Although these figures suggest that the disease does not materially

affect the boys educational progress the masters insist that they cannot get full value out of the infected children and one must remember that in Iraq only those children above average intelligence are sent for education.

Amongst the adult population of Basrah the disease is not often met with yet of a batch of thirty prisoners from the civil jail 33% were infected. I have been unable to obtain sufficient results on which to base a definite estimate of the incidence of Bilharzia among girls and adult women. I should think however, that the incidence is considerably lower than in the case of males.

It is interesting to compare these figures with those available from Egypt. Kautsky [XXV] found that 79% out of 124 boys in a school near Cairo were infected. He does not indicate the age of the boys and I gather that the School is situated outside of Cairo and therefore more strictly comparable to a rural district in Iraq.
Dr. Elgood [XXVI] working among women and children in Egypt found that :-

27.5% of the girls in a middle class school were infected
20.5% " " " " " better " " " "
3.2% of women were infected.

More recent statistics quoted by Leiper [XXVII] put down the incidence among men in Egypt as varying between 44% and 70. in different localities and at El Marg he found 49 out of 54 boys infected.

The source of infection in Basrah is not difficult to find. The distal ends of the main creeks reach just beyond the limit of the gardens and formerly formed loops which allowed the water to circulate from one to another. The banks of these loops have for several years been uncared for and in many places have collapsed bringing about the formation of large stagnant pools which are only disturbed by exceptionally high tides. In these molluscs breed freely. In the same way many of the smaller channels near the desert have fallen out of use and have become overgrown with weeds. On the course of the main creeks I have never been able to find molluscs and attribute their absence to the continuous movement of the water there resulting from the action of the tide and the

coming and going of "bellams" or local sailing craft.
It may also be stated that a good number of domestic ducks inhabit these creeks. All the same it is in these main creeks that infection most frequently takes place and thus can be accounted for by the countless cercariae carried down in the water from the terminal reaches to the canals each time the tide recedes. The concentration of cercariae in the large volume of water in these main creeks is low and would therefore be unlikely to give rise to a heavy type of infection. Clinical experience in Basrah bears out the fact that the type of infection prevalent is of a very mild character. Enquiry elicited the fact that school children complain most of their symptoms in Autumn that is four months after the season at which they most frequently bathe in the creeks.

As has been said the symptoms presented in cases met with in Basrah are mild. The rash and itching produced by the passage of the cercariae through skin is rarely complained of. The population is so much accustomed to the bites of fleas, sandflies, and mosquitos that all skin irritations are liable to be attributed to such causes. Symptoms may be latent and the patient quite unaware of his infection. The early symptoms are malaise and a slight burning sensation in the urethra during and especially towards the end of micturition. Then a few drops of blood appear accompanying the last few drops of urine. In six of the twenty two boys in the 1st. Primary class in 1922, i.e. the class showing the highest percentage of infections, visible blood was present mixed with the urine as it was passed. It can be readily understood that anaemia frequently results. The grosser complications mentioned as being frequent in the rural districts where a heavy type of infection predominates are rarely met with in Basrah residents. Amongst a large number of school boys treated the only genito-urinary complications I noted were one case of acute epididymitis, two cases of persistent urethral discharge showing ova but nothing to suggest a gonoccocal infection and two cases of urethral calculi required meatotomy for their removal. The effect of the disease on the

child's general physique has already been referred to and I agree with Christopherson who attributes this to a chronic toxaemia which may result from Bilharzia infection unaccompanied by superadded pyogenic infection. In the mild cases met with in Basrah rectal symptoms are, but only occasionally met with. None of the school boys complained of rectal discharge but such discharge was sometimes met with in cases coming to the civil Hospital from outside the town. No cases of Rectal popillomata were noted in Basrah but the recent work of Scinderson and Mills in Baghdad has shown that such papillomata do occur as a result of a pure Schistosma Haematobium infection. No cases were noted which would suggest that either ova or worms had invaded the general systemic circulation.

The diagnosis is easily established by examination of freshly passed urine under a low power microscope. Fairley has introduced a complement fixation test to aid the diagnosis but this is of much more value in cases due to Schistosoma Mansoni where the female worm, as has been noted lays a much smaller number of ova. Eosinphilia is an almost constant feature of the disease. I have never met with ova showing a lateral spine in Iraq so far as my experience goes Bilharzia in that country is always due to infection with Schistosoma Haematobium.

In Basrah the problem of anti Bilharzia measures is a complicated one. The demands both of the population and of the gardens for a constant and ample supply of water from the main creeks will remain and consequently any comprehensive scheme to carry out the drying process cannot be adopted. As funds become available much good may be done by the regular cleaning out and repairing of the terminal reaches of the creeks and smaller channels so that their water becomes subject to constant changing and movement under the influence of the tide. Antimalarial measures in the shape of oiling the surface of collections of standing water are at the same time antibilharzial measures for cercariae can no more live under a film of oil than can mosquito larvae.

The elaboration of the existing stand pipe water supply from the main river and the building of swimming baths the water in which could be rendered non infective by chemical treatment (Cresol 1 in 10,000) are measures which will go a long way to reduce the incidence of the disease but such schemes call for the expenditure of large sums of money which are not at present available. In a town like Basrah where the whole population is within easy reach of a hospital, where the occupation of the majority of the residents does not necessitate their exposing themselves to skin infection, and where even if they do come in such contact with infected water the risk of a heavy infection is small on account of the low concentration of cercariae in the water, in such a town the prospect of curative treatment being of real value is good. It must however be accompanied by an educational campaign especially in the Schools.

The success of the modern treatment of Bilharzia by intravenous injections of tartar emetic as suggested by Christopherson has been proved over and over again in Egypt but as that writer points out the dosage has not been thoroughly established. A note on the results of treatment I carried out on Basrah school boys may be valuable from the point of view of dosage, efficacy and practicability.

The administration of a drug like Potassium Antimony Tartrate, is not a process to be undertaken light heartedly. Apart from the attendant risks and discomfort, the actual administration, in the case of restless children with small veins, is an operation requiring much care and considerable skill which can only be acquired by practice. The children are never keen on needle punctures and the parents, although anxious to have their children cured, fail to see the necessity of continuing treatment after the obvious symptoms disappear as they do as the result of a few injections. Consequently the course of many children was frequently interrupted while that of others was never completed. A number of results from courses carried out in 1920-21 is appended.

These results suggested that for an effective cure a total dose of one grain for each year of the child's age was necessary

1920 - 21

Name	Severity of infection X being an average Basrah infection	Age.	All living ova disappeared after.	All ova both living & dead disappeared after.	Total amt. given.	Duration of Trtmt.	No of Inc j.	Ova in urine exd 5 wks ltr.	Ova in urine 9 mnth later.
Yusuf Eliahow	x x	8	gr. $2\frac{1}{4}$	gr. $3\frac{3}{4}$	gr. 8	4 weeks	12	nil	nil
Abdul	x	8	gr. $2\frac{1}{2}$	gr. $2\frac{1}{2}$	gr. $7\frac{3}{4}$	4 weeks	13	nil	yes
Abdul Aziz Mukhlaf	x	9	gr. $2\frac{3}{4}$	gr. $2\frac{3}{4}$	gr. $9\frac{1}{4}$	3 weeks	15	nil	nil
Abid Abdullah	x x	10	gr. $5\frac{3}{4}$	still presnt.	gr. $10\frac{1}{4}$	3 weeks	15	ova still present	nil
Abdul Kadir Mohammed	x	9	gr. $2\frac{1}{2}$	gr. $2\frac{1}{2}$	gr. 9	3 weeks	14	nil	nil
Abdul Aziz Quasim	x	11	gr. $3\frac{1}{2}$	gr. $3\frac{1}{2}$	gr. $10\frac{5}{8}$	4 weeks	14	nil	yes
Mohammed Hussan	x	10	gr. $1\frac{3}{4}$	gr. $3\frac{1}{2}$	gr. $9\frac{5}{8}$	3 weeks	13	nil	nil
Abdul Wahid	x	12	gr. $3\frac{1}{2}$	gr. $3\frac{1}{2}$	gr. $10\frac{5}{8}$	4 weeks	12	nil	yes
Nori Arab	x	9	gr. $2\frac{1}{2}$	gr. 3.	gr. $6\frac{5}{8}$	4 weeks	9	nil	nil
Saleh Baqir	xxx	10	gr. $4\frac{1}{2}$	gr. $6\frac{1}{2}$	gr. 8	4 weeks	12	nil	yes

1921-22.

Name	Age	Total amt. given.	Duration of Treatment	Number of injections	Ova in urine at end of treatment	Ova in urine 7 months later.
Hamid Naqi	16	gr. 16	3 weeks	16	nil	nil
Mehsin Hussan	18	" 20	4 weeks	19	nil	nil
Ahmed Nauroos	18	" 20	5 weeks	20	nil	nil
Talib Rahim	15	" 15	3 weeks	15	nil	nil
Eleahow Yusif	11	" 11¼	3 weeks	13	nil	nil
Selim Khalaf	12	" 13	4 weeks	14	nil	nil
Naji Yusuf	11	" 11	3 weeks	13	nil	nil
Selim Yusuf	12	" 13	3 weeks	14	nil	nil
Matook Dawood	12	" 12½	4 weeks	14	nil	not examined
Abdul Wahab	13	" 13½	4 weeks	13	nil	nil
S. Haik	19	" 20¼	3 weeks	14	nil	nil
E. Haik	17	" 18¼	3 weeks	16	nil	nil
Rahman Seleh	18	" 18	4 weeks	15	nil	nil
Naji Rahmin	11	" 12	2 weeks	12	nil	nil

The condition re-appeared in 33 1/3rd% of the cases so dosed within nine months but as a very hot summer had intervened and as all the boys admitted to having bathed frequently in the creeks these were probably cases of re-infection. Of boys who discontinued attendance for treatment after they had received an amount of Tartar Emetic equal to more than •5 grains less than •75 grains for each year of their age all except one were still passing ova six months later. Next Session I therefore chose for treatment older boys and warned them against the danger of bathing in the creeks. I based their dosage on the conclusions formed the previous year, all became free from symptoms and remained free at least seven months.

I used throughout a 1% solution of Potassium Antimony Tartrate giving an initial dose for Gr ¼ and doubling the dose each day until the maximum was reached. The smaller children could rarely tolerate more than gr. ½ and the bigger ones gr. 1 at each injection. The first year I gave injections on alternate days but the second year I found it advisable to avoid unpleasant symptoms by giving smaller doses without a day intervening between the injections. These unpleasant symptoms consist of retching vomiting and a most distressing feeling of tightness in the chest and they rarely appear with the initial gr. ¼ dose.

The dose with which they will appear varies so much with the individual that the amount given should be increased gr ⅛ each time until the maximum tolerated is discovered. Although these side effects are distressing in no case did they reach the stage of causing the operator genuine alarm nor did collapse, muscular pain or jaundice follow the treatment.

In the case of Basrah, then, complete preventative measures are not practicable but curative treatment can be carried out with success and is of value as the majority of the population can, if they are instructed how to do so, reduce the risk of reinfection to an almost negligible point.

It is remarkable how rarely Europeans become infected with Bilharzia in Iraq. I only know of one European case amongst the civil population and up till the end of 1918 only three European

Military cases have occurred. At the end of 1920, however, an outbreak occurred in the British Garrison at Kufa on the middle Euphrates. A most careful investigation of this outbreak was carried out and many valuable observations regarding it were recorded by the Lt. Col. A.E. Hammerton, D.S.O., R.A.M.C., Assistant director of Pathology and from his report I am able, through the courtesy of Lt. J.D. Graham, D.S.O., late I.G. Iraq Health Service, to make the following extracts. When it became apparent that infection of the British Troops who garrisoned Kufa during the last quarter of 1920 had taken place all the available men of that Garrison were examined (April 1921) and of a total of 495 men examined 111 were passing numerous ova in their urine. Many of these men had by this time been transferred to Hinaidi contonment near Baghdad and if the intermediate host were present were likely to spread the infection. Col. Hammerton therefore made a collection of the snails which inhabited the numerous slow flowing and weedy channels which intersected the contonment and which supplied all contonment water except a piped chlorinated supply for drinking. These he sent through the director of pathology at the War Office to the British Museum where they were classified thus.

1. Species known to be intermediate Hosts of Schistosomes

   (a) Isedora (Vel Bullinus) contorta - common in weedy channels & ponds.

   (b) Planorbis Species doubtful rare and not likely to be a danger.

2. Species not known to be hosts of Schistosomes

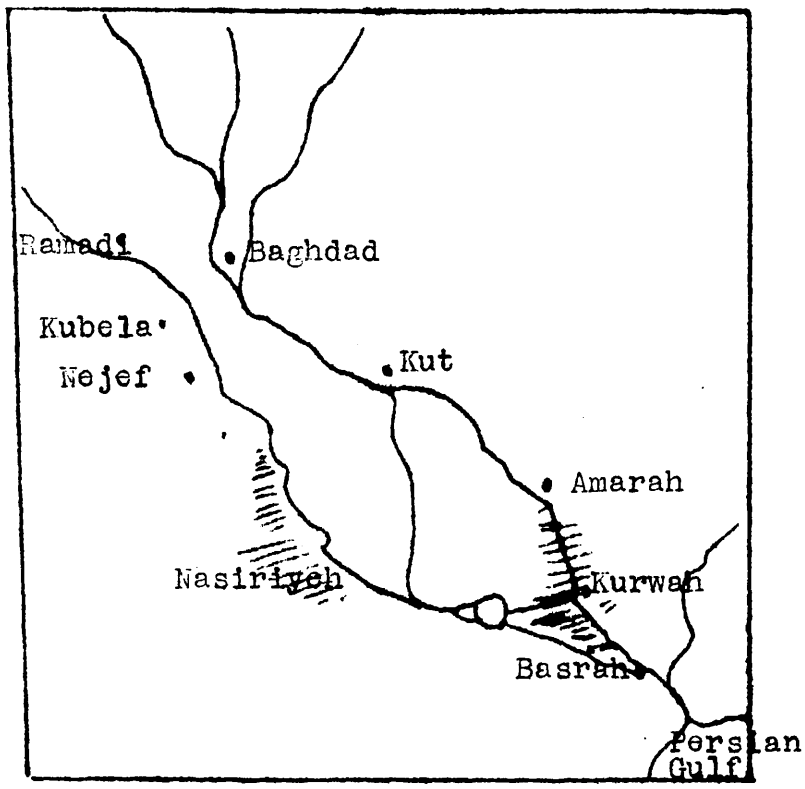
   (a) Limnaea Persica - very common
   (b) Fruticola Obstructa - common
   (c) Malanopsia Nodosa - uncommon
   (d) Ena Petracus - uncommon

Of 250 snails dissected none were infected with cercariae of Schistosoma H. In two snails however cercariae of an undetermined species were found. As the intermediate hosts were found to be present Col. Hammerton carried out various larvicidal tests with a view to finding out how best to break the life cycle.

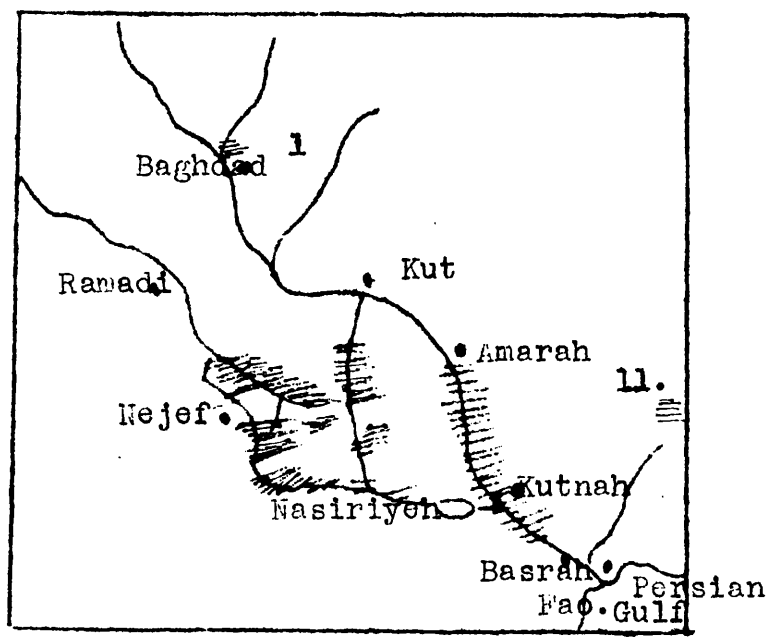
He found :-

Bullinus Snails thrived in a glass aquarium containing cresol

Map from Boulengers report. Shaded areas show the areas in which the disease was known to prevail in 1918.



Map showing areas from which I have seen patients suffering from Bilharzia and other areas in green from which reports of cases have been published.



1. Sanderson & Mills.
11. Harrison.

solution 1 in one million.

Ova of Schistosomum H. In similar solution hatch quickly but soon appear paralysed and motionless.

Cercariae (undetermined)

In cresol dilution	1 - 10000	were killed in	3	minutes	
" " "	1 - 100000	" "	10	"	
" " "	1 - 200000	" "	12	""	
" " "	1 - 500000	" "	15	"	
" " "	1 - 1000000	" "	4	hours.	

He then arranged that cresol to make a dilution of 1 in 1,000,000 was delivered into the water entering the channels (Mosquito larvae cannot live in this more than 48 hours) with a view to destroying larvae but after several months trial mosquito larvae and other small pond life were still as numerous as ever in the channels. On investigation it was found that the cresol formed with the soil an inert compound - aluminate of phenol - "This"as Col. Hammerton says, "is another proof of the limitations of laboratory experiments". Therefore he had all the channels & ponds well cleared out and the rate of flow of the water increased while once every three months the water was entirely cut off for a period of 14 days. These measures produced an undoubted reduction in the snail population

SUMMARY.

1. Bilharziosis is endemic in Iraq.
2. It is widespread throughout the country and is not confined to the areas unaffected by the tide of the Persian Gulf.
3. In Iraq it is always due to infection by Schistosoma Haematobium.
4. Its effect on the population both rural and urban is so marked that the disease must be considered an important factor in the economic development of the country.
5. It is liable to be spread to other countries.
6. Anti Bilharzia measures hold out reasonable prospect of success and should be put into operation.
7. For the success of such measures close co-operation is required between the departments of Health, Irrigation & Education.

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